to extend our inquiries. In bringing our labours to a termination, we feel very strongly that many of the subjects with which we have dealt need much further elucidation by perseverance in experimental research of the kind which we have pursued. We are convinced that if the work which we are relinquishing were continued, the knowledge of the conditions to be fulfilled for securing safety from preventable disasters, and the development of resources and appliances calculated to promote the fulfilment of those conditions, could still be much advanced. It is moreover certain that new subjects for inquiry connected with the safe working of coal-mines must continue to present themselves, as has been the case during our seven years' experience. These considerations have impressed upon us the need for the official establishment of some permanent arrangement by which the continuous pursuit of this highly important class of work would be secured, and by which, also, the merits of suggestions and inventions presenting themselves from time to time would be investigated properly and thoroughly, and dealt with authoritatively. We consider, moreover, that the complete investigation of coal-mine disasters would be greatly promoted if the arrangements to which we have referred were utilised systematically, in connection with the usual official inquiries, in dealing with the difficulties which frequently arise in elucidating the causes of these disasters.

WARINGTON W. SMYTH. THOS. BURT.
CRAWFORD AND BALCARRES. R. B. CLIFTON.
GEORGE ELLIOT. W. THOMAS LEWIS.
F. A. ABEL. LINDSAY WOOD.
JOHN TYNDALL.

March 15, 1886

SCIENTIFIC SERIALS

IN the *Journal of Botany* for March Mr. G. A. Holt describes and figures a species of moss, *Thamnium angustifolium*, not only new to Britain, but new to science. It was found sparingly in Derbyshire.—Mr. J. G. Baker concludes his comparison of the British and Continental forms of the difficult genus *Rubus*.

Proceedings of the Linnean Society of New South Wales, vol. x. part 3, Sydney, December 21, 1885.—This part contains the proceedings of this most energetic Society for July, August, and September, 1885, and memoirs by the following:—Dr. R. von Lendenfeld, monograph of the Australian sponges, part 5 (plates 26–35). The Auleninæ, order 3, the Ceraospongiæ, Halme, Aphrodite, Aulena, and Halmopses are established as new genera. part 6 (plates 36–38), on the genus Euspongia.—On a sponge destructive to oyster culture in the Clarence River, a new species of Chalinulæ.—Addendum to the Australian sponges.—Addendum to the Australian Hydromedusæ.—Note on the Glacial period in Australia.—W. A. Haswell, M.A., jottings from the Biological Laboratory of the Sydney University, on an Australian species of Bonellia; on a greater respiration in fresh-water turtles. From observations on the Australian *Chelodina longicollis*, thinks the phenomena described by S. H. Gage as auxiliary respiration extremely improbable and that the Chelonian can bear with impunity being deprived of oxygen for lengthened periods; but the facts recorded by Simon and Susanne Gage in the March 1886 number of the *American Naturalist* cannot thus be interpreted.—Capt. Hutton, on the supposed Glacial period in Australia.—N. de Miklouho-Maclay, plants used by the natives of the Macleay Coast, named by Baron Müller.—George Masters, catalogue of the hitherto-described Coleoptera of Australia, part 1, Cicindelidæ and Carabidos (960 species enumerated).—J. Douglas-Ogilby, three new fishes from Port Jackson; notes on the distribution of some Australian sharks and rays.—A. Sidney Olliff, new species of Australian Coleoptera belonging to the genera Lacordairia, Xanthophæa, Plagioteium, Catosiopus, and Rhysodes.—W. Macleay, on a new genus (Phalacrognathus) of the sub family Lamprimides.—Rev. Dr. Wools, on double flowers.—K. H. Bennettt, remarks on the decay of certain species of Eucalyptus. The species were almost without exception *E. mellidora* and *E. rostrata*, and the cause is ascribed to the enormous increase in the numbers of the opossums. Some idea of the number of this animal in a portion of Gipps' Land may be had from the fact that four men in a short time procured a quarter of a million of skins.

Rivista Scientifico-Industriale, February 28.—Description of a new telescope, the "plesiotelescope," by Prof. Nicodemo Jadanza. This is an astronomical instrument intended for the study of near and distant objects. It is constructed with an achromatic objective, M, to the second focus of which is attached a second lens, N, at a less focal distance than that of the lens M. These two lenses form a compound objective, which brings into view objects at short and great distances.—A new application of electrolysis, by G. F. The anonymous author describes a process for producing damascened work rapidly and economically by electrolysis.—Note on the explosion of boilers in steam-engines, by Prof. Giovanni Luvini. The author traces the bursting of boilers to their chief causes, suggests a practical remedy, and offers some remarks on a means of generating steam with a saving of fuel.—A description of Prof. E. Lommel's aërostatic scales for determining the specific weight of gases, by G. Faè.

Bulletin de l'Académie Royale de Belgique, January.—Description of some crystals of calcite, by Prof. C. Casaro. The author describes a first series of Belgian calcites, comprising the crystals found along the left bank of the Meuse and in some other localities. These are reduced to thirty-two simple forms, of which three are new.—On the difference of sea-level in winter and summer, by Gen. Commines de Marsilly. It is argued that the Polar seas must be higher in summer than in winter, when the accumulation of ice increases the salinity, consequently also the density, of the water.—Note on the display of meteors observed throughout Belgium on November 27, 1885, by F. Folie. The maximum of intensity was generally about 6 p.m., when as many as 155 meteors were observed in a single minute at Louvain.—A contribution to the study of the germ-cell in the lower animal organisms, by C. Van Bambeke.—On the coefficient of internal friction of fluids: determination of its variations according to temperature. Theoretical considerations suggested by the observation of these variations, by P. de Heen.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 11.—"On Systems of Circles and Spheres." By R. Lachlan, B.A., Fellow of Trinity College, Cambridge. Communicated by Prof. A. Cayley, F.R.S.

This memoir is an attempt to develop the ideas contained in two papers to be found in the volume of "Clifford's Mathematical Papers" (Macmillan, 1882), viz. "On Power Co-ordinates" (pp. 546–55), and "On the Powers of Spheres" (pp. 332–36). The conception of the "*power* of two circles," or spheres, as an extension of Steiner's use of the "*power* of a point with respect to a circle," is due to Darboux.

The memoir is divided into three parts: Part I. consists of the discussion of systems of circles in one plane; Part II. of systems of circles on the surface of a sphere; and Part III. of systems of spheres.

The power of two circles is defined to be the square of the distance between their centres less the sum of the squares of their radii.

Denoting the power of the circles (1, 2) by $\pi_{1,2}$ it is proved that the powers of any five circles (1, 2, 3, 4, 5) with respect to any other circles (6, 7, 8, 9, 10) are connected by the relation—

$$\begin{vmatrix} \pi_{1,6} & \pi_{1,7} & \pi_{1,8} & \pi_{1,9} & \pi_{1,10} \\ \pi_{2,6} & \pi_{2,7} & \pi_{2,8} & \pi_{2,9} & \pi_{2,10} \\ \pi_{3,6} & \pi_{3,7} & \pi_{3,8} & \pi_{3,9} & \pi_{3,10} \\ \pi_{4,6} & \pi_{4,7} & \pi_{4,8} & \pi_{4,9} & \pi_{4,10} \\ \pi_{5,6} & \pi_{5,7} & \pi_{5,8} & \pi_{5,9} & \pi_{5,10} \end{vmatrix} = 0,$$

which may be conveniently written—

$$\pi\begin{pmatrix} 1, & 2, & 3, & 4, & 5 \\ 6, & 7, & 8, & 9, & 10 \end{pmatrix} = 0.$$

This is the fundamental theorem of the paper; it is shown that, if the power of a straight line and a circle be defined as the perpendicular from the centre of the circle on the straight line, and the power of two straight lines as the cosine of the angle between them, then the theorem is true if any circles of either system be replaced by points, straight lines, or the line at infinity.

The general theorem is then applied to prove some properties of special systems of circles, and more particularly those systems

of circles which have analogous relations to three circles, as the circum-circle, the inscribed, and nine-points circle of a triangle have to the straight lines forming the triangle.

The rest of Part I. is taken up with a discussion of equations expressed in terms of power-co-ordinates. The "power-co-ordinates" of a point are defined as any multiples of its powers with respect to a system of four circles which have not got a common orthogonal circle.

The equation of the first degree represents a circle, or straight line; and the equation of the second degree a bicircular quartic, or circular cubic, and these curves are discussed in some detail.

Part II. contains merely the extension of the results of Part I. to spherical geometry; the power of two circles on a sphere is defined to be $\tan r \tan r' \cos\omega$, where r, r' are their radii, ω their angle of intersection: the power of a small circle, radius r, and a great circle is defined as $\tan r \cos\omega$, and the power of two great circles as $\cos\omega$.

The fundamental theorem is as before

$$\pi \begin{pmatrix} 1, & 2, & 3, & 4, & 5 \\ 6, & 7, & 8, & 9, & 10 \end{pmatrix} = 0,$$

connecting the powers of the systems of circles.

Consequently the results obtained previously are extended with but slight modification.

In Part III. the method of Part I. is applied to spheres; it is proved at once that the powers of two systems of spheres must satisfy the relation

$$\pi \begin{pmatrix} 1, & 2, & 3, & 4, & 5, & 6 \\ 7, & 8, & 9, & 10, & 11, & 12 \end{pmatrix} = 0,$$

where any of the spheres may be replaced by planes, or the plane at infinity.

The discussion of the equation of the first degree in power-co-ordinates is much the same as that in Part I. The equation of the second degree represents a cyclide of the fourth or third order, but the reduction of the equation to its simplest form is more complicated than in the case of bicircular quartics. It is shown that there are four distinct canonical forms, each of which includes several species of surfaces. The different species are then discussed in detail.

March 25.—"Remarks on the Cloaca and on the Copulatory Organs of the Amniota." By Dr. Hans Gadow. Communicated by Prof. M Foster, Sec.R.S.

The first portion of this communication contains an account of the sphincter and copulatory muscles, the derivation of which from skeletal and from visceral muscles is followed up in the Sauropsida and Mammalia, partly aided by the study of the nerve-supply.

Then follows an extensive description of the modifications of the cloaca of the chief groups of the Amniota. Hatteria comes nearest the Amphibia. Chelonia represent a type intermediate between that of the Ostriches and Crocodiles, and that of the Monotremes, from which again a continuity of stages up to the highest Placentalia can be traced.

The anal sacs of the Chelonia are discussed with reference to experiments on their being able to take in water. The peritoneal canals of Crocodiles and Tortoises are still functional, but in Hatteria they are rudimentary. Muellerian ducts are present in the males and Wolffian ducts in the females of young Crocodiles. Space will not permit to mention more than the following of the general conclusions drawn regarding the phylogenetic development and the homologies of the various organs treated in this paper.

The whole cloaca of the Amniota consists originally, either permanently or in the embryo only, of three successive chambers, which may be distinguished as follows:—

I. The Proctodæum (termed thus by Prof. Lankester). It is the outermost anal chamber of epiblastic origin. With its derivatives: (1) bursa Fabricii in birds; (2) various hedonic glands in most Amniota; (3) the copulatory organs, the at least partly epiblastic nature of which is indicated by the frequently developed horny armament of the glans, by the various sebaceous glands, and, as shown in this paper, by its development.

II. The Urodæum, from οὖρον and δαίω. Hypoblastic. This is the middle chamber or primitive cloaca, into which open the urinogenital ducts, and through which pass the fæces. With its differentiations: (1) urinary bladder, ventral; (2) anal sacs in Tortoises, dorsal.

III. The Coprodæum, from κόπρος and δαίω. This is the innermost cloacal chamber.

The Urodæum is the oldest portion of the whole cloaca, then follows the Proctodæum, and, lastly, the Coprodæum has secondarily assumed cloacal functions.

The various modifications of these three chambers, their function, and the gradual separation of fæces, urine, and genital products have been discussed in the third chapter.

We can derive the types of the intromittent organs and of the cloaca of the Amniota from conditions which are still represented by the Gymnophiona and by Hatteria, viz. from the walls of the Proctodæum in connection with a certain uro-proctodæal fold. Then Lizards and Snakes followed one line leading to the development of paired organs, whilst the other Amniota modified the same substratum into another, unpaired, ventral form. The Carinatæ show a degeneration in this respect.

The extraordinary resemblance of the organs dealt with in this paper to those of the Chelonia and young Crocodiles can hardly be explained by homoplastic coincidence, but strongly favours the phylogenetic relationship of the Mammalia with the Reptiles. This, however, is but one more link in the long chain, which, being anchored in the Triassic Theriomorpha, makes the Amniota more akin to each other than to the Amphibia.

April 1.—"Description of Fossil Remains of Two Species of a Megalanian Genus (*Meiolania*, Ow.) from Lord Howe's Island." By Sir Richard Owen, K.C.B., F.R.S.

In a scientific survey by the Department of Mines, New South Wales, of Lord Howe's Island, fossil remains were obtained which were transmitted to the British Museum of Natural History, and were confided to the author for determination and description.

These fossils, referable to the extinct family of horned Saurians described in former volumes of the *Philosophical Transactions* (vol. cxlix., 1858, p. 43; *ib.* 1880, p. 1037; *ib.* 1881, p. 1037) under the generic name *Megalania*, form the subject of the present paper. They represent species smaller in size than *Megalania prisca*, Ow., and with other differential characters on which an allied genus *Meiolania* is founded. Characters of an almost entire skull with part of the lower jaw-bone, of some vertebræ and parts of the scapula and pelvic arches, are assigned to the species *Meiolania platyceps*. Portions of a cranium and mandible are referred to a *Meiolania minor*. Both species, as in *Megalania*, are edentulous with modifications of the mouth indicative of a horny beak, as in the Chelonian order. The cranial and vertebral characters are, however, sauroid. Horn-cores in three pairs are present, but shorter relatively, especially the first and third pairs, than in *Megalania prisca*. The indication of a seventh more advanced and medial horn is feeble, and the author remarks that in the small existing lizard (*Moloch*) this horn has not an osseous support. The tail of *Meiolania* is long and stiff; the vertebræ being incased by an osseous sheath, developing, as in *Megalania*, tuberous processes in two pairs, corresponding with the vertebræ within: such defensive parts are less developed, relatively, than in *Megalania prisca*.

The locality of these singular remains is an insular tract not exceeding 6 miles by 1 mile in extent, situated midway between Sydney and Norfolk Island, in lat. 31° 31′ S., long. 159° 9′ E. The island is formed of three raised basaltic masses connected by low-lying grounds of blown coral-sand formation, consisting of rounded grains and fragments of corals and shells. In the parts of this formation converted into rock were found the petrified remains which are the subject of the present paper. It is accompanied by drawings of the most instructive fossils: these form the subjects of five plates illustrative of the text.

Mathematical Society, April 8.—Mr. J. W. L. Glaisher, F.R.S., President, in the chair.—The following communications were made:—On the number of linearly independent invariants (or seminvariants), reciprocants, or in general of integrals of any assigned type of a homogeneous and isobaric linear partial differential equation, by Prof. Sylvester, F.R.S.—On some results connected with the theory of reciprocants, by C. Leudesdorf.—The President (Mr. Walker, F.R.S., in the chair) gave an account of the work he has been for some time engaged upon in connection with elliptic functions, the special points he drew attention to being the use of the twelve elliptic functions, and of twelve zeta and twelve theta functions. The two latter systems of functions depend upon the quantities E, G, I, where $G = E - k'K$ and $I = E - K$.—Mr. A. B. Kempe, F.R.S., communicated a note on an extension of ordinary algebra differing from the latter in the substitution of three arbitrary quantities z, i, and u, for the

quantities 0, 1, and ∞. Taking z, i, and u to be 0, 6, and 1 respectively, he showed that $2 + 2 = 3$, $2 \times 2 = 3\frac{1}{3}$.—Mr. Tucker read a theorem in conics, by the Rev. T. C. Simmons. Through the focus K of an ellipse chords LKL', MKM' are drawn at angles of 60° with the major axis. A new ellipse is described having K for focus, and LM', ML' for tangents at vertices. Then it will follow that (1) the new ellipse will have the same directrix as the former; (2) its eccentricity will equal half that of former; (3) an infinite number of triangles inscribed in the outer, may be circumscribed about the latter; (4) if the outer ellipse be projected orthogonally into a circle, these projected triangles will all have K for symmedian point, the inner ellipse for Brocard ellipse, and the projections of the intersections of LL', MM', with the inner minor axis for Brocard points; (5) the sine of the Brocard angle will be the ratio of the minor axes of the ellipses, the ratio of the Brocard diameter to the circum-radius will be the eccentricity of the outer ellipse, &c.

Geological Society, March 24.—Prof. J. W. Judd, F.R.S., President, in the chair.—Henry Fisher, Edwin Harman, Henry Johnson, and Edward Alloway Parkhurst were proposed as Fellows of the Society.—The following communications were read:—On the genus *Diphyphyllum*, Lonsdale, by James Thomson, F.G.S.—On additional evidence of the occurrence of glacial conditions in the Palæozoic era, and on the geological age of the beds containing plants of Mesozoic type in India and Australia, by Dr. W. T. Blanford, F.R.S., Sec.G.S. After recapitulating briefly the principal facts known as to the correlation of the Karoo formation of South Africa, the Gondwána system of India, and the coal-measures and associated beds of Eastern Australia, and especially noticing those phenomena in the different strata that had been attributed to the action of ice, the author proceeded to describe the additions recently made to previous knowledge by various members, past or present, of the Geological Survey of India, and especially by Mr. R. Oldham and Dr. Waagen. These additions had recently been published in the Records of the Geological Survey of India. Mr. R. Oldham, in a recent visit to Australia, had come to the same conclusion as all other geologists who had visited the country, and clearly showed, as the Rev. W. B. Clarke and many others had done, that beds containing *Glossopteris*, *Phyllotheca*, and *Nœggerathiopsis* were intercalated among marine beds with Carboniferous fossils. The age of these marine beds was shown by Dr. Waagen to be that of the European coal-measures. Mr. Oldham had, however, further ascertained the presence in abundance of smoothed and striated boulders, evidently transported by ice, in the marine Carboniferous beds north of Newcastle, N.S.W., and he consequently considered these beds, and not the overlying Hawkesbury, the equivalents of the Bacchus-marsh beds of Victoria, and of the Talchirs of India, a view which was in accordance with the relations of the fossil flora. Meantime Dr. Waagen had received from Dr. H. Warth some fossils from the Salt-range of the Punjab. The fossils came from the upper part of a boulder-bed, the resemblance of which to the Talchir group at the base of the Gondwána system had long been recognised, but which had hitherto been classed with a stage immediately overlying, containing Upper Cretaceous fossils. The fossils now found by Dr. Warth included two forms of *Conularia* found in the Australian Carboniferous rocks, besides some other species evidently of Carboniferous age. Dr. Waagen consequently classed the boulder-bed together with other similar formations in other parts of the Salt-range as Carboniferous. There was one difficulty, the fossils just referred to were considered by Mr. Wynne to be contained in pebbles derivative from another bed. It was, however, shown that this did not affect the age of other boulder-beds in the Salt-range, and that the latter were connected with the Talchir beds in Central India by another discovery of Mr. R. Oldham's, that a boulder-bed in the Indian deserts was also probably of Talchir age, and that the question as to whether the nodules containing the *Conulariæ*, &c., were concretions or pebbles might await further examination in the field. Another contribution to the question had been made by Mr. Griesbach, who had recently found a boulder-bed which, from its character and fossils, he considered as Talchir, in the neighbourhood of Herat. It was pointed out that the existence, over such extensive areas, of boulder-beds, all of which might, without any improbability, be of approximately the same age, rendered it highly probable that all were really contemporaneous and due to one Glacial period; that this period must have been towards the close of the Palæozoic era, which it may possibly have terminated by exterminating many of the principal forms of life. The peculiar flora of the Australian Newcastle beds and of the Indian Damudas, having nothing in common with the contemporaneous European Carboniferous flora, afforded an important proof of distinct botanical provinces in past times.

Geologists' Association, April 2.—On grasses, by J. Starkie Gardner, F.L.S. The paper was an inquiry as to the geological period at which grasses first commenced to assume a preponderating position in vegetation. Their value and importance at the present day was first sketched, and it was remarked that they occupy under cultivation one-third of the entire area of Europe, inclusive of lakes and mountains, while, exclusive of malt and spirituous drinks distilled from them, their products to the value of nearly one hundred millions sterling are imported annually into this country alone. There are over 3000 species, fitted to occupy most diverse stations and to overcome nearly every kind of competition under no matter what conditions, with the result that about 95 per cent. of the plants growing in ordinary meadow-land are grasses. The conclusion arrived at was that there was no great development of grasses until towards the close of the Eocene, no definite remains being associated with any of the older Eocene floras of temperate latitudes. A number of facts were brought forward to show that grasses could by no possibility have failed to become associated with the remains of other plants in beds deposited under such conditions as those of the Eocene had they existed in any profusion then, while further to support this argument it was stated that the very similar Oligocene and Miocene beds all over Europe are crowded with them. Further it was shown that the dentition of all the early Eocene herbivorous Mammalia was adapted for crunching fruits, snapping twigs, and grubbing up roots, rather than for browsing on such food as grass, so that the evolution of true Graminivora, as well as the specialised Carnivora that prey on them, must be post-dated to the appearance of the grass itself. The geological history of the whole class of insects was reviewed, with the object of supporting the conclusion arrived at as to the *post* mid-Eocene date of grass. Older remains of grass may, however, occur in the vast series of Tertiary deposits in Spitzbergen, but as yet their age has not been accurately correlated. Finally, it was shown that the introduction of an aggressive type in vast numbers and of different habits to pre-existing vegetation, exerted an influence on terrestrial life altogether without parallel, and for the first time rendered possible the development of a meadow and prairie vegetation, as distinct from that of marsh, scrub, and forest, with all the attendant forms of animal and vegetable life to which such vegetation is indispensable.

Physical Society, March 27.—Prof. W. G. Adams, Vice-President, in the chair.—Mr. A. R. Wright was elected a Member of the Society.—The Chairman read a letter from Dr. Alder Wright, Secretary to the "Tribe Fund" Committee, in which reference was made to the scientific work of the late Mr. Alfred Tribe, and an appeal made for funds to aid in the maintenance and education of his family, which, owing to his early death, has been left in straitened circumstances.—The following communications were read:—On an arc lamp convenient for use with the Duboscq lantern, by Prof. S. P. Thompson. The old Duboscq lamp, though working well with a series of Grove's cells, is very unsuitable for use with currents from dynamos. Prof. Thompson has employed as a substitute in the Duboscq lantern a lamp commonly known as the "Belfast arc lamp." The result is all that can be desired as regards steadiness and regularity. The focusing, that is, the adjustment of the arc so that it shall remain unchanged in position, is effected by a wheel below the lantern, which is moved by hand.—On a modified Maxwell's galvanometer, by Prof. S. P. Thompson. The galvanometer consists of a light frame of copper, upon which is a coil of wire. This is suspended between the poles of a horse-shoe magnet, and a piece of soft iron is placed within the coil, but free from it, which concentrates the magnetic force between the poles. The coil is suspended by two silver wires, by which it is in connection with two binding screws on the base of the instrument. The galvanometer is extremely simple in adjustment, and very dead beat; it has also the advantage of being affected to an inappreciable extent by neighbouring magnets and currents, with a current in its own coils; when no current is in it, it is of course quite unaffected. The reading is effected by the ordinary lamp, mirror, and scale arrangement.—On the expansion

of mercury between 0° and – 39° C., by Profs. W. E. Ayrton and John Perry. On November 14, 1885, Mr. G. M. Whipple gave the Society the results of the examination of thermometers down to the melting-point of mercury. There was, however, no evidence as to whether the contraction of the mercury continued uniform, as the thermometers were only compared with mercurial ones. The authors have therefore examined this point, and have made a series of comparisons of a mercurial thermometer, lent them by Mr. Whipple, with a constant volume air-thermometer, both immersed in a bath of frozen mercury, which was allowed to gradually become warm. The result obtained was that no certain deviation from a linear law could be detected in the expansion of mercury when temperature was measured by the increase of pressure required to keep a volume of air constant. Hence temperatures down to – 39° C. may be correctly measured by a mercury thermometer the stem of which is graduated for equal volumes.—On the expansion produced by amalgamation, by Profs. W. E. Ayrton and John Perry. It has been accidentally observed by the authors that the amalgamation of brass is accompanied by great expansive force. If one edge of a straight thick brass bar be amalgamated, it will be found that in a short time the bar is curved, the amalgamated edge being always convex, and the opposite concave. The authors imagine that a similar action may be the primary cause of the phenomena presented by the Japanese "magic mirrors." Japanese mirrors are made of bronze, and have a pattern cast upon the back, and although to the eye no trace of it can be discovered upon the polished reflecting surface, yet, when light is reflected by certain of these mirrors on to a screen, the pattern is distinctly visible in the luminous patch formed. In a paper before the Royal Society they have shown that this is due to the polished side opposite the thinner parts of the casting being more convex than the others, a conclusion verified by the fact that the pattern is reversed when formed by a convergent beam of light. Such a condition of things would evidently result from a uniform expansive stress taking place over the reflecting surface, the thinner, and consequently the weaker, parts becoming more convex or less concave than the others. The authors have hitherto attributed this inequality of curvature to a mechanical distortion to which the mirrors are intentionally submitted during manufacture, to produce the general convexity of the polished surface, but they now think it possible that the use of a mercury amalgam in the process of polishing may have an effect in the production of this inequality of curvature.

Victoria (Philosophical) Institute, April 5.—A paper by Mr. W. P. James, F.L.S., giving a careful *résumé* of the various records of the Creation current among nations in ancient and modern times, was read.

Institution of Civil Engineers, April 6.—Sir Frederick Bramwell, F.R.S., President, in the chair.—The paper read was on water-purification: its biological and chemical basis, by Percy F. Frankland, Ph.D.

DUBLIN

Royal Society, February 17.—Physical, Experimental, and Applied Science Sections.—Prof. W. F. Barrett in the chair.—Prof. E. Hull, LL.D., F.R.S., read a paper on the different varieties of Irish paving sets. The use of Irish paving materials is of comparatively recent date, North Wales having been the chief source of supply. Granite, which affords comparatively tough paving sets, capable of preserving a rough surface, is worked at Bessbrook, Goraghwood, and Castlewellan. Whinstone, similar to that of Penmaenmawr in Wales, and from rocks of the same group, is worked at Ballintoy, Co. Antrim, and Arklow, Co. Wicklow. The author expressed the opinion that sets of the granitoid class were most serviceable in those parts of a city where the traffic was of an ordinary character, but where it was excessive in quantity and weight paving-stones of the whinstone class, especially if largely crystalline, were preferable.—On a sine and tangent galvanometer, by Prof. G. F. Fitzgerald, F.R.S.—An improved method for determining the specific gravity of solids, by R. J. Moss, F.C.S. This is an application of Sprengel's specific-gravity tube to solids. The tube employed consists of two parts fitting together by an accurately-ground joint the full width of the tube. The error arising from this joint may easily be reduced to one-tenth of a milligramme. With a tube of 1 cubic centimetre capacity, about 2 grammes of most minerals can be employed. If benzene or turpentine be used instead of water, no difficulty arises with air-bubbles. Results sufficiently accurate for determinative purposes can be obtained with even 20 milligrammes of the solid body.

Natural Science Section.—Prof. J. P. O'Reilly, C.E., in the chair.—On some recent discoveries in the salt-range, Punjab, by Mr. A. B. Wynne. Certain peculiarities of the section at different parts of the range were described, and attention was called to the absence of any recognisable Devonian formation in the neighbouring parts of the country, as well as in the salt-range itself, which added interest to the recent discovery by Dr. H. Warth of fossils believed to be of Devonian age, occurring as rolled and derived or transported inclusions of some of the later Jurassic or Cretaceous conglomerates. Specimens of these fossils were exhibited; the most characteristic is Conularia. It was suggested as probable that the parent beds lay to the southward. Other cases of derivative fragments amongst the Salt-Range series having an equally obscure origin were mentioned, all pointing to a lost land, perhaps buried under the deserts and alluvial tracts stretching away into Sind.—On the relationship of the structure of rocks to the conditions of their formation, by H. J. Johnston-Lavis, M.D. Communicated by Rev. Dr. S. Haughton, F.R.S.

EDINBURGH

Mathematical Society, April 9.—Dr. R. M. Ferguson, President, in the chair.—Mr. J. S. Mackay communicated a note on the divisibility of certain numbers.—Mr. R. E. Allardice discussed the projective geometry of the sphere.—Mr. John Alison gave statical proofs of several geometrical theorems.

PARIS

Academy of Sciences, April 5.—M. Jurien de la Gravière, President, in the chair.—Obituary notice of M. A. Lallemand, Member of the Section for Physics, by M. Mascart.—On the constitution of the earth's crust (concluded), by M. Faye. The author concludes that the revolutions of the globe are due, not to contraction caused by a general and uniform chilling process, as hitherto supposed, but to the circumstance, peculiar to the earth, that this chilling process goes on at an accelerated rate and more deeply under the marine basins than under the continents.—On the magnetic perturbation observed throughout France on March 30, by M. Mascart. The disturbance, which began about 8.30 a.m., lasted for over two days, gradually dying out on April 1.—Summary remarks on the fauna of Tonquin, by M. Emile Blanchard. These remarks are made in connection with a collection of insects made in the delta of the Red River by M. Langue, and recently forwarded to the Paris Natural History Museum. It comprises 567 species of Coleopteræ, 90 of Lepidopteræ, and a few of Hemipteræ, Neuropteræ, and other orders. Most of them are common to the rest of Indo-China, but several are new, either indigenous or related to genera represented by more or less divergent species occurring in other parts of the peninsula. This collection shows that on the whole a considerable degree of uniformity characterises the local fauna throughout all the coast-lands of Indo-China.—Note on the specimen of rock brought by M. Lesseps from the hill at Gamboa, on the line of the Panama Canal, by M. Fouqué. This specimen, picked up after the explosion by which the hill was removed, is described as a microlithic volcanic rock, an augitic labradorite with optical properties analogous to those usually occurring in volcanic labradorites.—Remarks on the rocks collected during the soundings of the *Talisman*, by MM. Fouqué and Michel Lévy. Amongst these specimens, mostly obtained from depths of from 4000 to 5000 metres, the older metamorphic is much more generally represented than the eruptive series. Sedimentary rocks also occur in considerable abundance including 73 specimens of limestones, 16 of arkoses, and 19 of sandstones, the latter sometimes rich in remains of biotite and muscovite.—A first experiment with an instrument intended to study the roll of vessels at sea, by Admiral Pâris.—Observations in connection with M. Resal's recent note on the flexion of prisms, by M. J. Boussinesq. The supposed error in M. de Saint-Venant's theory of the flexion of prisms with elliptical base is shown to be due to a mistake made by M. Resal himself in his calculations.—Description of an automatic instrument designed to register the heat liberated by living organisms (one illustration), by M. A. d'Arsonval. By means of this extremely sensitive "thermo-electric calorimeter" the physiologist is enabled to determine and measure the quantity of heat liberated by cold-blooded animals, such as frogs and fishes, and even by

inferior organisms, such as insects and larvæ.—Observations on the new planet 254, discovered by M. Palisa at Vienna on March 31, made at the Paris Observatory, by M. G. Bigourdan.—Note on the number of poles at the surface of a magnetic body, by M. Stieltjes.—Construction of the left curve of the sixth order and first genus: transformation of the surface of the third order on a plane, by M. A. Petot.—Note on the late M. Dupuy de Lôme's theory of submarine vessels, by M. Zédé.—Remarks in connection with the preceding note, and on M. Dupuy de Lôme's projected submarine boat, by Admiral Pâris. It is pointed out that the problem of submarine navigation was practically solved in the year 1858 by Admiral Bourgeois, who who actually sailed under water in his *Plongeur*, a model of which is still preserved in the Naval Museum, Paris.—Note on a calculator of steam and fluids at high pressure, by M. Henri Parenty.—On the mathematical problem of anamorphosis, by M. Léon Lecornu.—On a new general method of graphic calculation by means of hexagonal abacuses, by M. Ch. Lallemand.—On the variation produced by a rise of temperature in the electromotor force of thermo-electric couples, by M. H. Le Chatelier.—Note on a new method of photographic reproduction without objective and by the simple reflection of light, by M. Boudet de Paris. The author's numerous experiments prove beyond doubt that a design, a photograph or object of any kind, may be reproduced photographically without the aid of the usual appliances, and with the light of a Carcel lamp.—Note on the tungstates and chlorotungstates of cerium, by M. P. Didier.—On the elimination of the oxide of carbon in cases of partial poisoning, by M. N. Gréhant.—Researches on the therapeutic action of urethane, by MM. A. Mairet and Combemale.—On the reproductive functions of *Doris testudinaria* and some other Gasteropods, by M. E. Bolot.—On some special variations of structure in the organs of the Simple Ascidians, by M. Louis Roule.—On a new process for preserving and economising the hops used in brewing, by M. Louis Boulé. For this process it is claimed that it effects a saving of one-half in the consumption of hops, which are at the same time made to preserve their efficacy for an indefinite period. If generally adopted it will reduce hops to a reasonable price, and remove the inducement to employ deleterious drugs as substitutes.

BERLIN

Physiological Society, January 29.—Prof. Ewald spoke on the significance of the so-called second swallowing noise. As was known, Kronecker and Meltzer, in their investigations into the mechanism of swallowing, had endeavoured to explain the second noise, audible by auscultation in the region of the stomach six seconds after the movement proper of swallowing, by setting forth that through the act of swallowing, the bit eaten was squirted into the upper part of the œsophagus, and then encountered the peristaltic wave of the œsophagus, where, after six seconds, it attained the lower part, and was pressed into the cardiac orifice. It was the contraction of the lower part of the œsophagus which produced the second noise in question. As the result of observations on sound and diseased persons, as also on animals, Prof. Ewald had arrived at another opinion. According to his view the second swallowing noise was generated by the entrance of air into the cardiac orifice. Both in the case of swallowing anything and also in the case of not swallowing anything, whether it were altogether empty swallowing or only saliva trickling down, air penetrated into the lower part of the œsophagus. Air might, however, likewise penetrate from the stomach upwards. In proof of the correctness of this interpretation of the second noise, there was first the fact that this phenomenon was absent when water was so carefully drunk that no air accompanied it on its passage to the cardiac orifice, and second that the noise was sometimes heard without any bit being swallowed. If, now, the second noise of swallowing had not the significance attached to it by Herren Kronecker and Meltzer, neither could it be regarded as any argument in favour of their view that, as had been maintained by these authors, the piece swallowed stayed for six seconds before the cardiac orifice till it got pressed into it. Far from such being the case, the piece swallowed passed continuously into the cardiac orifice, and finally the co-entering air got pressed, with emission of noise, through the sphincter into the stomach.—Dr. Pohl-Pincus gave a sketch of his experiments designed to determine the influence of excitement of spirits and passionate feelings on the hair of the head. Except in the case of one phenomenon, these experiments proved without result. Through long years' experience he had by facts established that in consequence of excitement the hair of the head showed a changed double refraction in the lowest part lying above the papilla, which he called the root-nodule (*Wurzelknötchen*). While under normal conditions this part of the hair appeared white when polarised, when under moderate excitement it fell out it showed the colouring of blue 1 to yellow 2. Under the highest degrees of excitement, again, the highest shades of colour appeared: blue 2 to yellow 3. What was the connection between this material change of the hair and the excitement could not be ascertained. No doubt the nourishment of the hair and the process of cornification of the hair-cells played a part in the matter.—Dr. H. Virchow produced a series of photographs in which the structure of the corpus ciliare in the eyes of various animals came out to view in its multiplicity.—Dr. Benda showed preparations of the central nervous system which were treated with copper hæmatoxyline, and shortly discussed the advantages of this method of colouring for brain and spinal-marrow preparations.

BOOKS AND PAMPHLETS RECEIVED

"Micro-Organisms and Disease," 3rd edition, revised by Dr. E. Klein (Macmillan).—"Nature and the Bible," 2 vols., by Dr. Fr. H. Reusch, translated by Kathleen Lyttelton (T. and T. Clark).—"Fancy Pigeons," parts 7 and 8, by J. C. Lyell (U. Gill).—"Poultry for Prizes and Profit," part 6, by James Long (U. Gill).—"British Cage-Birds," parts 7 and 8, by R. L. Wallace (U. Gill).—"Bees and Bee-keeping," part 8, by F. R. Cheshire (U. Gill).—"Book of the Goat," part 7, by H. S. H. Pegler (U. Gill).—"An Intermediate Physical and Descriptive Geography," new edition (Stanford).—"British Petrography," part 3, April, by J. J. H Teall (Watson, Birmingham).—"The Rotifera or Wheel Animalcules," part 3, by C. T. Hudson and P. H. Gosse (Longmans).—"Journal of Anatomy and Physiology," vol. xx. part 3, April (Williams and Norgate).—"China: Imperial Maritime Customs, Medical Reports for the half year ended March 31, 1885" (Shanghai).—"Notes from the Leyden Museum," vol. viii., No. 2, April (Brill, Leyden).

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